IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 5, Issue 3, March 2018

# Reinstate River Sand by Salvaged Super-Structure Waste

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**Abstract**: This paper reports the experimental investigation on the basic properties of recycled brick-mortar fine aggregate and compares them with natural fine aggregates. Use of recycled aggregate in concrete can be useful to reduce the environmental contamination. Basic changes in every aggregate property are resolved and their impacts on cementing work are examined. Indispensable concrete properties are observed where compressive strength & split tensile strength for full replacement of recycled brick-mortar fine aggregate (RBM) instead of natural fine aggregate.

**Keywords:** Salvaged Super-Structure Waste, Recycled Brick-Mortar Fine Aggregate (RBM), Compressive strength, Split tensile strength.

## I. INTRODUCTION

Natural sand has been used in the construction activities and is diminishing day by day. At present due to the unavailability of natural sand, manufactured sand produced from quarries are widely used for mass production of concrete. Very soon in the near future there will be a scarcity for manufactured sand also. Use of recycled products is the new trend in industry and researchers are keen to find a new material that fit for the right purpose. Here super-structure waste can be effectively utilized as full replacement of natural sand or manufactured sand. Our project intimates on the replacement of river sand by the super-structure waste of the building.

### A. *Objectives of using recycled brick-mortar fine aggregate (RFA):*

- To minimize the waste.
- To minimize volumes accumulating and taking over area within the waste dumping yard.
- To reduce the prices of storage and disposal.
- To reduce the extraction of natural sand.
- To reduce the extraction of natural sand.

### B. *Scope of the work:*

The scope of the present work includes the study of the following topics:

- Characterization of recycled brick-mortar fine aggregate.
- Mix design for M25 grade concrete with full replacement with recycled brick-mortar fine aggregate.
- Study on properties of fresh and hardened concrete with the replacement of fine aggregate.
- Experimental studies on behavior of concrete with recycled brick-mortar fine aggregate.

## II. LITERATURE REVIEW

### A. *Full Replacement of Fine Aggregate in Concrete with Crushed Ceramic Waste.*

*Authors: Amos Kiptoo Koech*

The objectives of the project were met and physical properties of concrete made using ceramic waste as fine aggregate were determined. From the study, Concrete produced by full replacement of river sand in concrete did not acquire compressive, and tensile strengths greater than or equal to that of river sand hence crushed ceramic fine aggregate should not be used as a replacement of river sand for class 25 tested.

### *B.* Effect of Recycled Waste Brick Fine Aggregate on Compressive Strength and Flexural Strength of Mortar

Authors: *Xian LI,Fujin WANG ,Fei LI*

The compressive and flexural strength of mortar specimen decreased with the increase of RS content while w/c ranges from 0.4 to 0.6. However, the long-term strength growth of RS mortar is more obvious. The inner curing effect of RS promotes the hydration of cement, which makes the l transition zone denser. The bonding between fine aggregate and hardened paste is stronger, which is beneficial to the further development of strength.

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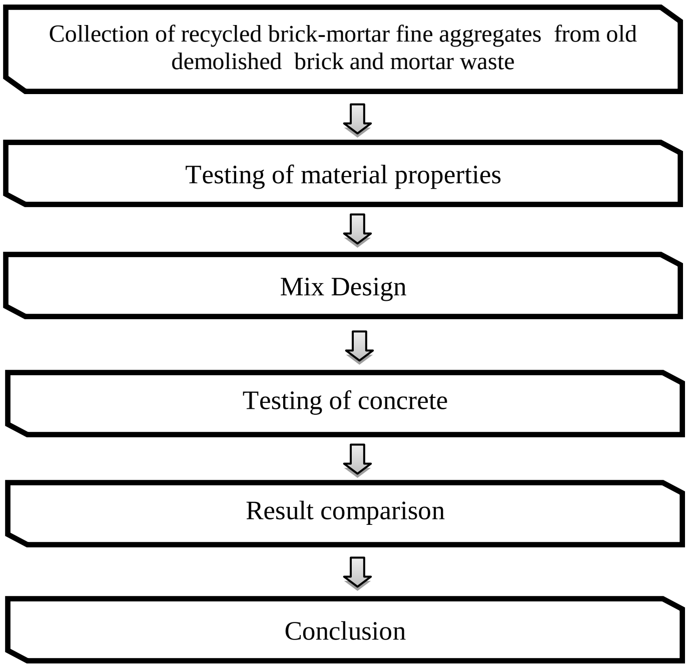
*C. Usage of Recycled Brick as Coarse Aggregate in Concrete*
Authors: *Rekha Kasi, Potharaju Malasani*
The similar procedure of mixing GA concrete can be adopted for the production of RBAC. However the RBA is coated with cement slurry before it is used in the concrete. Both the aggregates shall be used in the SSD condition. The impact and crushing values of RBA are higher than the GA but within the acceptable limits as prescribed by IS 383-1972.

*D. Utilization of Brick Fine Aggregate in Concrete*
Authors: *Tarek Uddin Mohammed*
Based on the results of this experimental work on utilization of brick fine aggregate (BFA) in concrete, The optimum replacement ratio of natural sand by BFA with respect to compressive strength, tensile strength, and Young's modulus of concrete is found at 30%, Relationships between compressive strength of concrete and tensile strength of concrete, and compressive strength and Young's modulus concrete are proposed for concrete made with BFA.

## III. METHODOLOGY




## IV MATERIALS USED

Material specification for concrete preparation has been mentioned below,

*A. Cement:*
Cement is defined as the product manufactured by burning and crushing to powder an intimate and well-proportioned mixture of calcareous and argillaceous materials. Cement is binding material in concrete which binds the other materials to form a compact mass. Generally OPC is used for all engineering construction works. The manufacture of OPC is decreasing all over the world in view of the popularity of blended cement on account of lower energy consumption, environmental pollution, economic and other technical reasons. In this project work 53 grade OPC cement is for experimental study.

*B. Water:*
Water used for preparation and curing concrete is free from injurious substances like oil, acid, alkali, sugar, salt, organic materials or different components harmful to concrete or steel. Portable water is appropriate for making concrete. Ocean water containing up to 35000 ppm of common salt and different salts is usually appropriate as combining water for plain concrete work.

*C. Coarse Aggregate:*
The aggregate having size more than 4.75 mm is termed as coarse aggregate. The graded coarse aggregate is described by its nominal size i.e. 40mm, 20mm, 16mm, 12.5mm etc. 80mm size is the maximum size that could be conveniently used for making concrete. Crushed stone aggregate with a maximum particle size of 12.5mm and 20mm was obtained from local quarry & was used as coarse aggregate. The Flakiness and Elongation Index were maintained well below 15%.


DOI 10.17148/IARJSET.2018.5318

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*D. Recycled brick mortar Waste (Fine Aggregate)*

In our project crushed brick mortar waste are used as a fine aggregate. Super-structure waste is collected from old building elements such as partition walls, main walls .Then the Waste was crushed in the stone crusher. The crushed waste is sieved and used. The size of crushed recycled brick mortar waste as fine aggregate is varying from 0.08mm to 2mm. Crushed recycled brick mortar waste size (pass on 2.36mm and retained 350 micron) in sieved and used.

## IV. TESTS CONDUCTED

We have compared the results of concrete made by crushed C&D wasted with normal concrete by conducting following tests.

*A. Test carried out for fine recycled aggregate*

- Sieve analysis
- Specific gravity test
- Water absorption test
- Bulking of sand
- Silt content

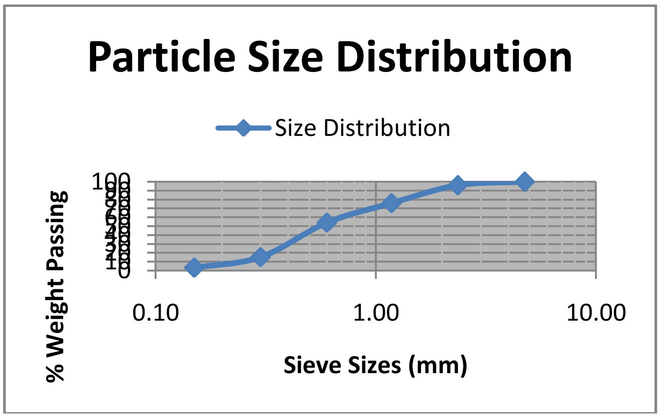
*B. Concrete load bearing capacity test*

- Compressive strength test
- Split tensile strength test

## V. MATERIAL TEST RESULTS

*A. Sieve Analysis:*

| IS Sieve Sizes | Recycled Fine Aggregate (Percentage Passing) | Remark |
|---|---|---|
| 4.75 mm | 100 | Conforming to grading Zone III of Table 4 of IS : 383-1970 |
| 2.36 mm | 100 | |
| 1.18 mm | 80 | |
| 600 micron | 65 | |
| 300 micron | 16 | |
| 150 micron | 3 | |




*B. Specific Gravity & Water Absorption*

| | | |
|---|---|---|
| **Specific gravity (SG)** | $= \frac{D}{C-(A-B)}$ | **Where,**<br>**A= Wt. of Pycnometer+Water+Sample**<br>**B= Wt. of Pycnometer+Water**<br>**C= Wt. of Sample taken**<br>**D= Wt. of Oven dry Sample** |
| **Apparent Specific gravity (ASG)** | $= \frac{D}{D-(A-B)}$ | |
| **Water Absorption (WA)** | **=((C-D)/D) ×100%** | |

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| TRIAL | OBSERVATION (kg) | | | | SG | Apparent SG | WA % |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | | | |
| 1 | 1.710 | 1.410 | 0.5 | 0.480 | 2.40 | 2.67 | 4.16 |
| 2 | 1.685 | 1.388 | 0.5 | 0.490 | 2.41 | 2.54 | 2.04 |
| 3 | 1.736 | 1.383 | 0.6 | 0.593 | 2.42 | 2.500 | 1.35 |
| **MEAN** | | | | | **2.41** | **2.57** | **2.51** |

*C. Bulking Of Sand*

| TRIAL | Values of Y | Bulking of Sand % | Mean Value % |
|---|---|---|---|
| 1 | 186.0 | 11.60 | **11.11** |
| 2 | 185.7 | 10.40 | |
| 3 | 185.8 | 11.33 | |

*D. Silt Content*

| TRIAL | VOLUME OF SILT (mm) | VOLUME OF SAMPLE (mm) | SILT CONTENT % | MEAN VALUE % |
|---|---|---|---|---|
| 1 | 3.6 | 197 | 1.81 | **1.87** |
| 2 | 3.7 | 196 | 1.88 | |
| 3 | 3.6 | 186 | 1.92 | |

## VI. MIX DESIGN

Mix design as per (IS 10262::1982)

| Mix design for M25 ( ***IS 10262:1982*** ) | |
|---|---|
| **1:1.32:3.10** | |
| WATER | 191.60 kg/$m^3$ |
| CEMENT | 383.20 kg/$m^3$ |
| RECYCLED FINE AGGREGATE | 505.16 kg/$m^3$ |
| NATURAL COARSE AGGREGATE | 1190.73 kg/$m^3$ |

## VII. COMPRESSIVE STRENGTH TEST RESULTS

| Strength Results of Concrete with RBM (N/$mm^2$) | 7 DAYS | 14 DAYS | 28 DAYS |
|---|---|---|---|
| Conventional Concrete | 13.78 | 22.22 | 24.11 |
| RBM | | | |
| With Silt Content | 12 | 17.33 | 24.78 |
| Without Silt Content | 8 | 11.56 | 23.44 |

## VIII.SPLIT TESNSILE STRENGTH TEST RESULTS

| Strength Results of Concrete with RBM (N/$mm^2$) | 7 DAYS | 14 DAYS | 28 DAYS |
|---|---|---|---|
| Conventional Concrete | 1.56 | 1.84 | 2.05 |
| RBM | | | |
| Without Removing Silt | 1.71 | 2.12 | 2.55 |

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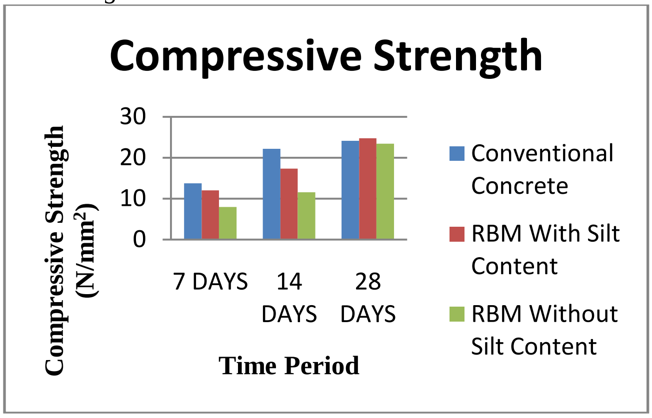
| | | | |
|---|---|---|---|
| Content | | | |
| After Removing Silt Content | 1.27 | 1.42 | 1.63 |

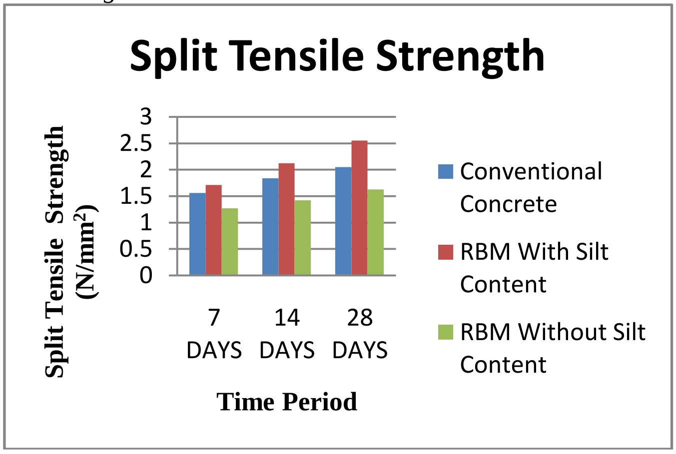
## IX. INTERPRETATION OF RESULTS

Results obtained from the above tests are compared with the conventional M25 mix concrete in the below chart.

*A. Compairsion of Compressive strength*




*B. Comparision of Split tensile strength*




## X. CONCLUSION

A conclusion can be drawn from the test results that the concrete produced with recycled fine aggregate gives almost as much as strength as normal concrete. Recycled brick-mortar fine aggregates produced from demolition waste can be utilized in concrete mixtures as a good substitute for natural sand. Further studies should be done to know how extensively we can use the RBM in construction. Using RBM in fresh concrete not only decreases the SSW wastes in the country, but also it will decrease the use of river sand and M Sand, which are both becoming hard to come by, and also it will reduce the cost of construction.

## REFERENCES

[1] IS 10262:1982 Indian Standards Recommended Guidelines For Concrete Mix Design.
[2] IS 383:1970 Specification For Coarse And Fine Aggregates From Natural Sources For Concrete.
[3] IS 2386:1963(Part 1 To 8) Methods Of Test For Aggregates For Concrete.
[4] IS 11269:2013 Ordinary Portland Cement, 53 Grade — Specification.
[5] IS 4031:1996 Method Of Physical Tests For Hydraulic Cement.
[6] IS 456:2000 Plain And Reinforced Concrete-Code Of Practice.